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DeSoto et al.

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(54) **LOGIN USING QR CODE**

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Related U.S. Application Data

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(60) Provisional application No. 61/600,444, filed on Feb. 17, 2012, provisional application No. 61/621,823, filed on Apr. 9, 2012.

(51) **Int. Cl.**

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H04L 29/06	(2006.01)
H04W 12/06	(2009.01)
G06F 21/62	(2013.01)

(52) **U.S. Cl.**

CPC ***H04L 63/08*** (2013.01); ***H04L 63/10*** (2013.01); ***H04W 12/06*** (2013.01)

(58) **Field of Classification Search**

CPC G06F 3/002; G06F 11/0742; G06F 21/35; G06F 21/36; G06F 21/40; G06Q 20/3274; G06Q 20/3276

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,314,167	B1	1/2008	Kiliccote	
8,261,089	B2	9/2012	Leon Cobos et al.	
8,272,038	B2	9/2012	Husemann et al.	
2003/0097444	A1 *	5/2003	Dutta et al.	709/225
2008/0320566	A1 *	12/2008	Herzog et al.	726/4
2010/0107229	A1 *	4/2010	Najafi et al.	726/6
2010/0257366	A1 *	10/2010	Leclercq et al.	713/173
2011/0137797	A1 *	6/2011	Stals	G06Q 20/02 705/44
2011/0270751	A1 *	11/2011	Csinger et al.	705/42
2012/0266224	A1 *	10/2012	Gruschka et al.	726/7
2012/0290838	A1 *	11/2012	Lee	713/168
2013/0185210	A1	7/2013	Dodson et al.	

OTHER PUBLICATIONS

2-clickAuth-Optical Challenge-Response Authentication. Vapen et al. IEEE(2010).*

* cited by examiner

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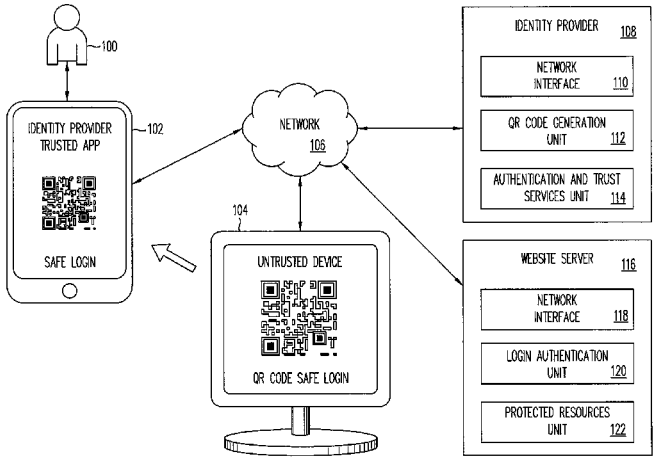
(57) **ABSTRACT**

Systems and methods are disclosed herein for a user to use a trusted device to provide sensitive information to an identity provider via QR (Quick Response) code for the identity provider to broker a website login or to collect information for the website. A user may securely transact with the website from unsecured devices by entering sensitive information into the trusted device. The identity provider may generate the QR code for display by the website on an unsecured device. A user running an application from the identity provider on the trusted device may scan the QR code to transmit the QR code to the identity provider. The identity provider may validate the QR code and may receive credential information to authenticate the user or may collect information for the website. Advantageously, the user may perform a safe login to the website from untrusted devices using the trusted device.

19 Claims, 7 Drawing Sheets



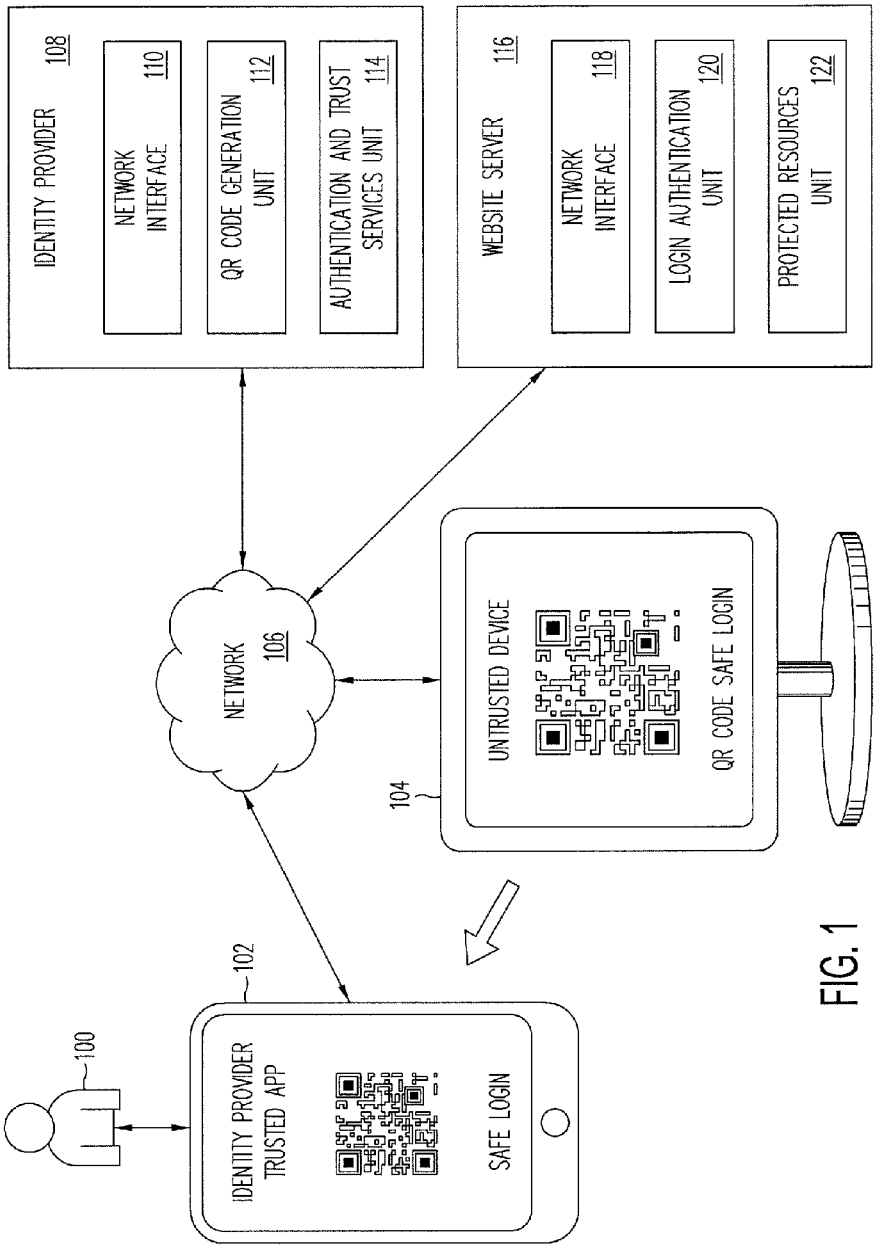

IDENTITY PROVIDER 108
NETWORK INTERFACE 110
QR CODE GENERATION UNIT 112
AUTHENTICATION AND TRUST SERVICES UNIT 114
WEBSITE SERVER 116
NETWORK INTERFACE 118
LOGIN AUTHENTICATION UNIT 120
PROTECTED RESOURCES UNIT 122
NETWORK 106
UNTRUSTED DEVICE
QR CODE SAFE LOGIN
104
102
IDENTITY PROVIDER TRUSTED APP
SAFE LOGIN
100

FIG. 1

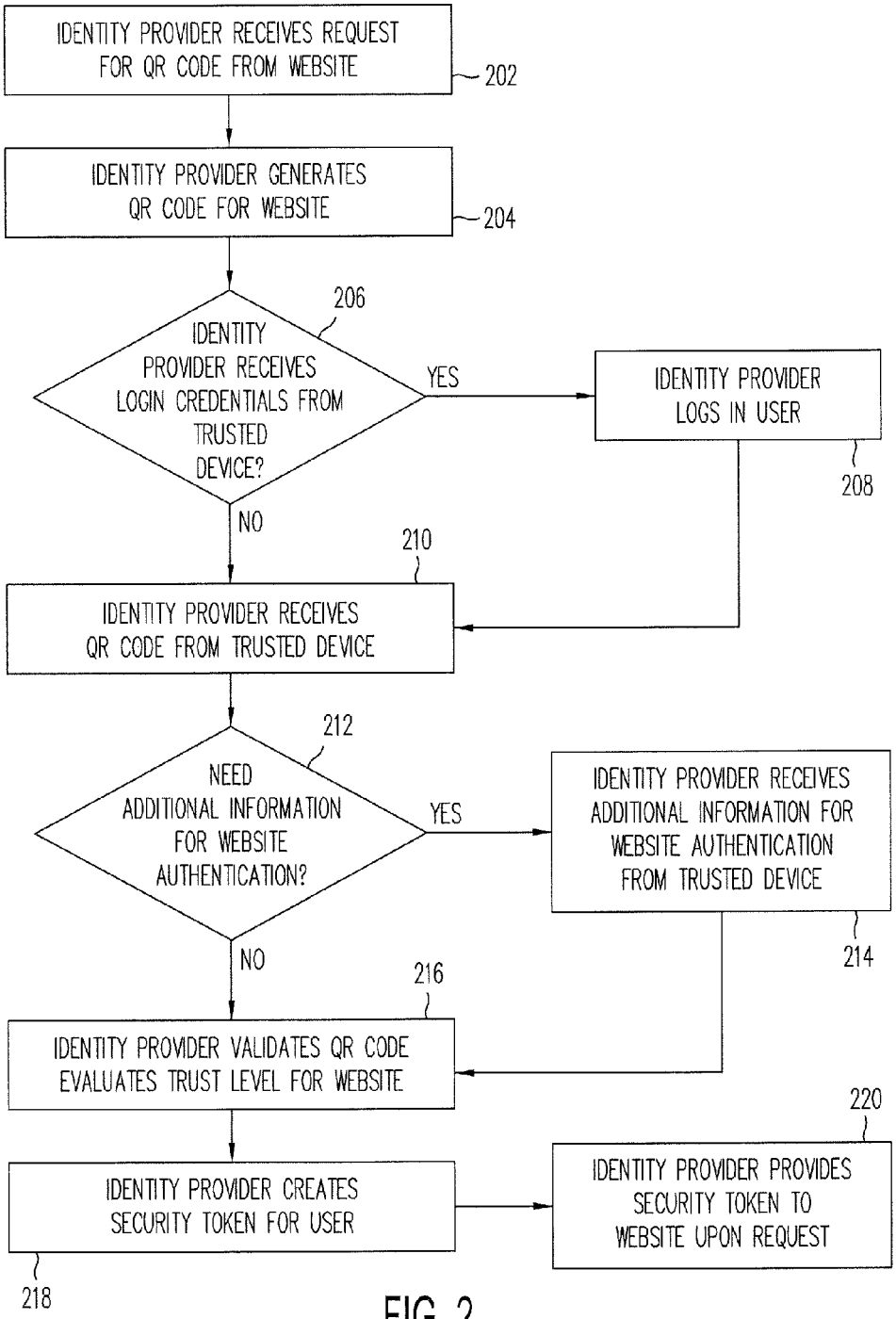

IDENTITY PROVIDER RECEIVES REQUEST FOR QR CODE FROM WEBSITE
202
IDENTITY PROVIDER GENERATES QR CODE FOR WEBSITE
204
206
IDENTITY PROVIDER RECEIVES LOGIN CREDENTIALS FROM TRUSTED DEVICE?
YES
IDENTITY PROVIDER LOGS IN USER
208
NO
210
IDENTITY PROVIDER RECEIVES QR CODE FROM TRUSTED DEVICE
212
NEED ADDITIONAL INFORMATION FOR WEBSITE AUTHENTICATION?
YES
IDENTITY PROVIDER RECEIVES ADDITIONAL INFORMATION FOR WEBSITE AUTHENTICATION FROM TRUSTED DEVICE
214
NO
216
IDENTITY PROVIDER VALIDATES QR CODE EVALUATES TRUST LEVEL FOR WEBSITE
220
IDENTITY PROVIDER CREATES SECURITY TOKEN FOR USER
IDENTITY PROVIDER PROVIDES SECURITY TOKEN TO WEBSITE UPON REQUEST
218

FIG. 2

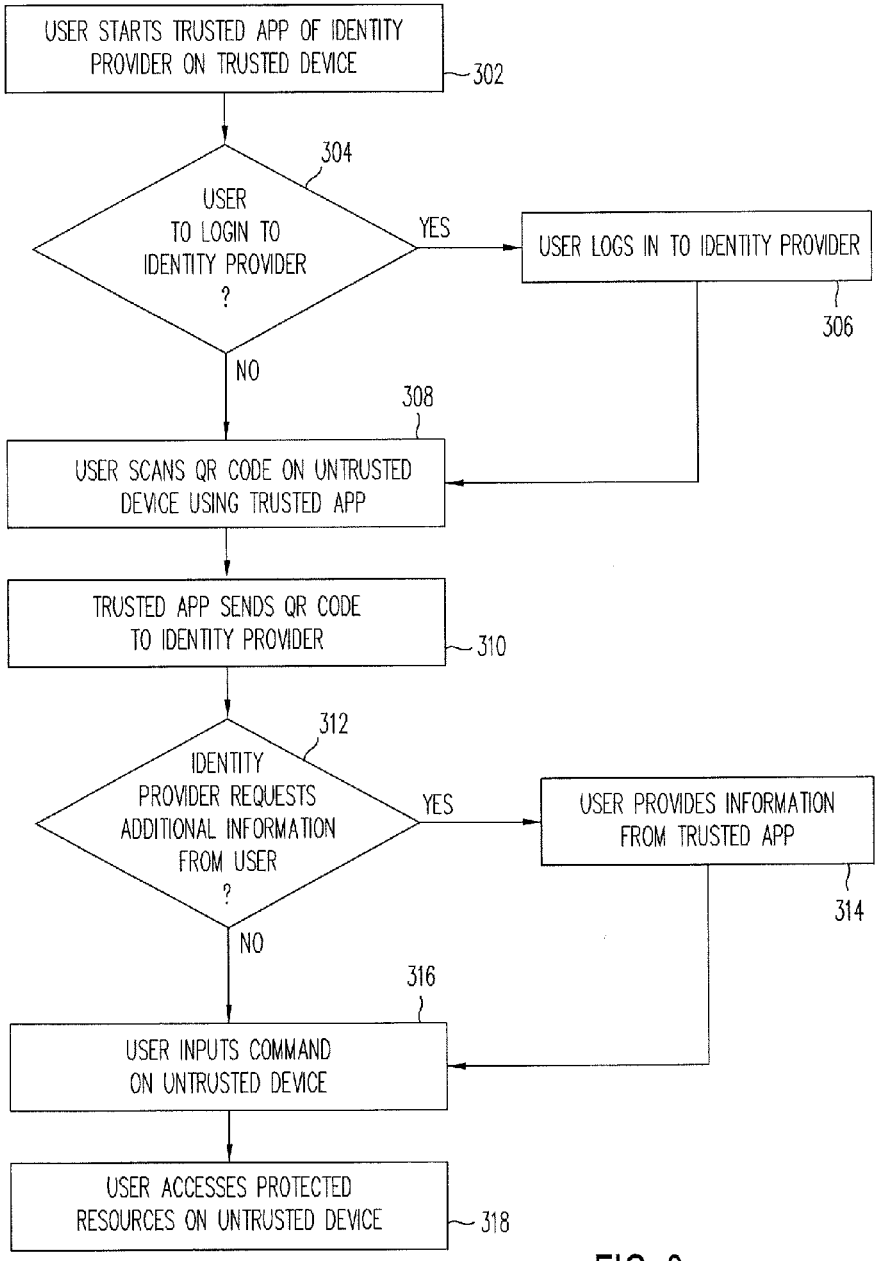

USER STARTS TRUSTED APP OF IDENTITY PROVIDER ON TRUSTED DEVICE
302
304
USER TO LOGIN TO IDENTITY PROVIDER ?
YES
USER LOGS IN TO IDENTITY PROVIDER
306
NO
308
USER SCANS QR CODE ON UNTRUSTED DEVICE USING TRUSTED APP
TRUSTED APP SENDS QR CODE TO IDENTITY PROVIDER
310
312
IDENTITY PROVIDER REQUESTS ADDITIONAL INFORMATION FROM USER ?
YES
USER PROVIDES INFORMATION FROM TRUSTED APP
314
NO
316
USER INPUTS COMMAND ON UNTRUSTED DEVICE
USER ACCESSES PROTECTED RESOURCES ON UNTRUSTED DEVICE
318

FIG. 3

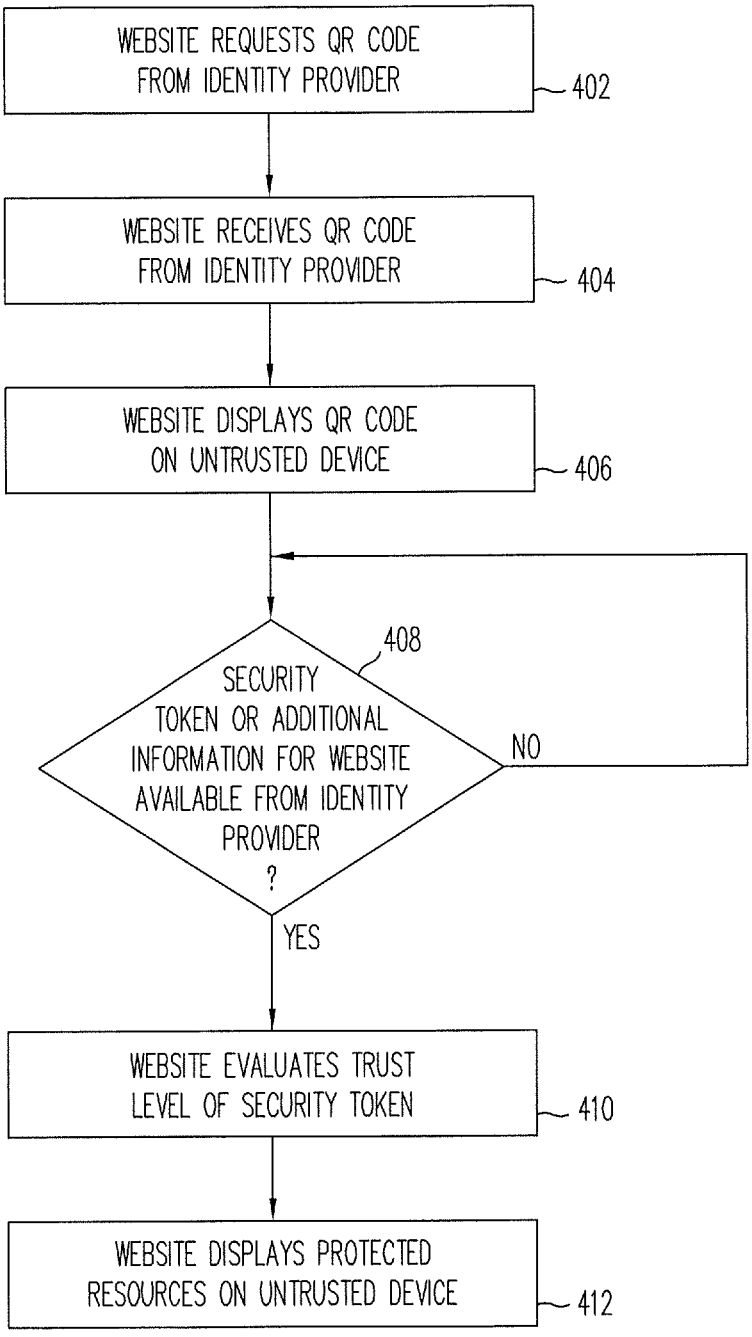

WEBSITE REQUESTS QR CODE FROM IDENTITY PROVIDER
402
WEBSITE RECEIVES QR CODE FROM IDENTITY PROVIDER
404
WEBSITE DISPLAYS QR CODE ON UNTRUSTED DEVICE
406
408
SECURITY TOKEN OR ADDITIONAL INFORMATION FOR WEBSITE AVAILABLE FROM IDENTITY PROVIDER ?
NO
YES
WEBSITE EVALUATES TRUST LEVEL OF SECURITY TOKEN
410
WEBSITE DISPLAYS PROTECTED RESOURCES ON UNTRUSTED DEVICE
412

FIG. 4

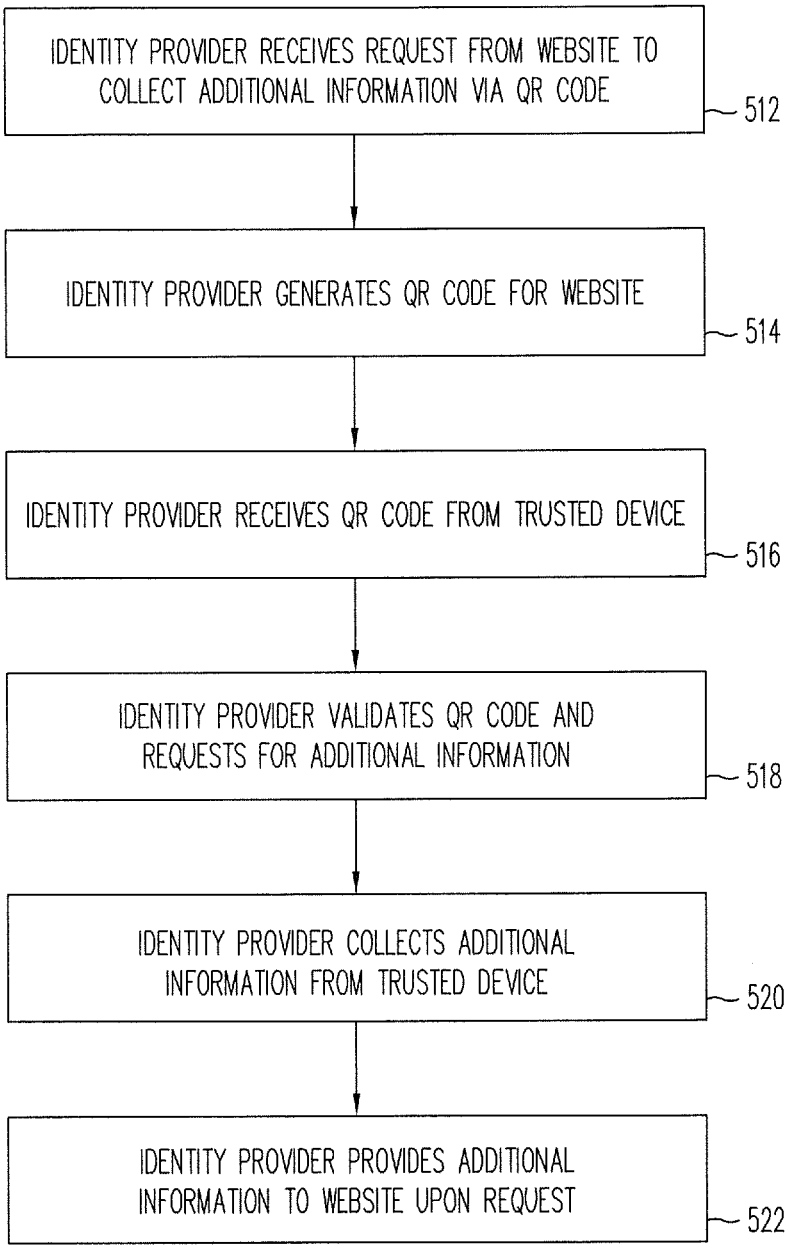

IDENTITY PROVIDER RECEIVES REQUEST FROM WEBSITE TO COLLECT ADDITIONAL INFORMATION VIA QR CODE
512
IDENTITY PROVIDER GENERATES QR CODE FOR WEBSITE
514
IDENTITY PROVIDER RECEIVES QR CODE FROM TRUSTED DEVICE
516
IDENTITY PROVIDER VALIDATES QR CODE AND REQUESTS FOR ADDITIONAL INFORMATION
518
IDENTITY PROVIDER COLLECTS ADDITIONAL INFORMATION FROM TRUSTED DEVICE
520
IDENTITY PROVIDER PROVIDES ADDITIONAL INFORMATION TO WEBSITE UPON REQUEST
522

FIG. 5

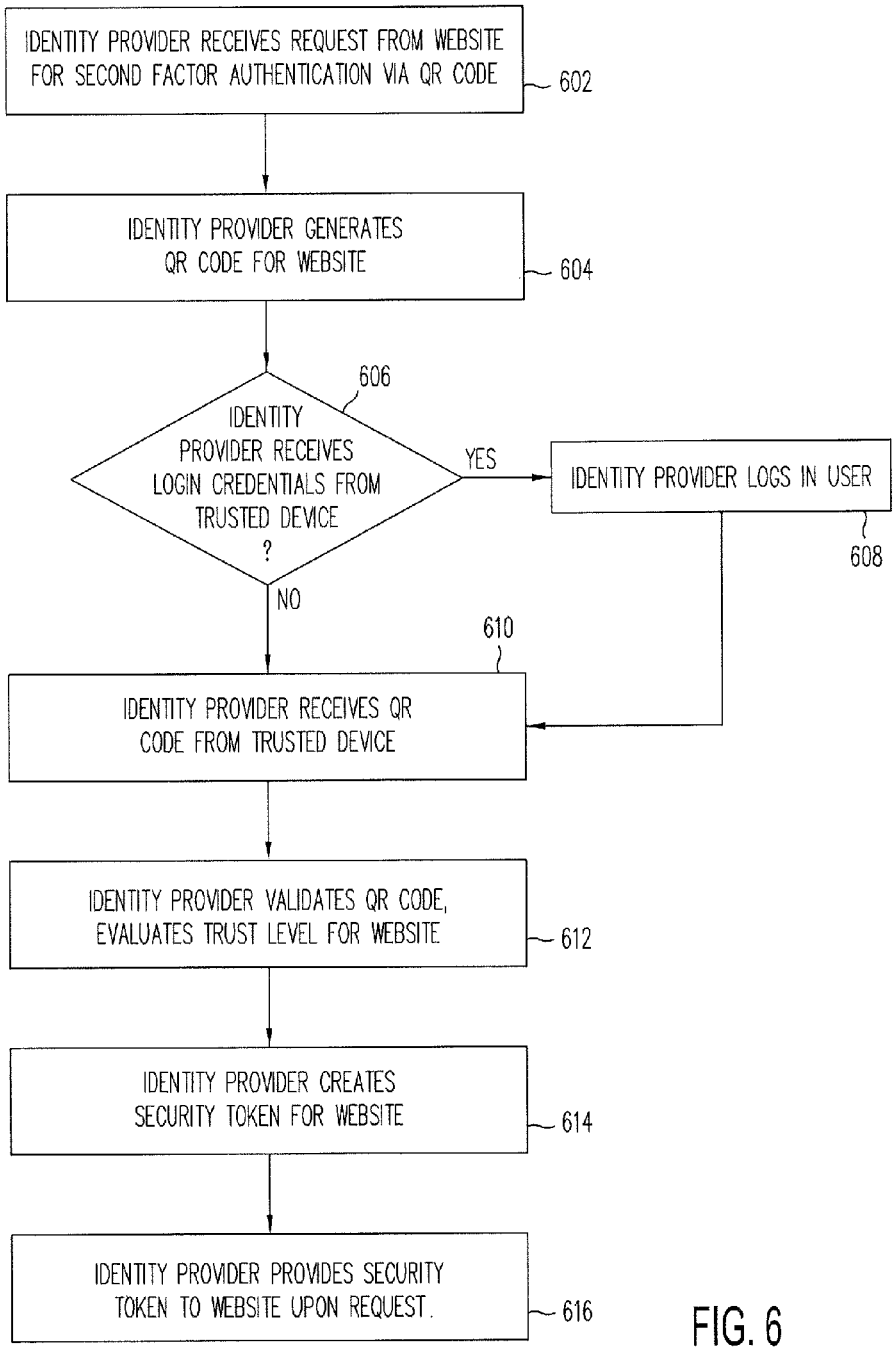

IDENTITY PROVIDER RECEIVES REQUEST FROM WEBSITE FOR SECOND FACTOR AUTHENTICATION VIA QR CODE
602
IDENTITY PROVIDER GENERATES QR CODE FOR WEBSITE
604
606
IDENTITY PROVIDER RECEIVES LOGIN CREDENTIALS FROM TRUSTED DEVICE ?
YES
IDENTITY PROVIDER LOGS IN USER
608
NO
610
IDENTITY PROVIDER RECEIVES QR CODE FROM TRUSTED DEVICE
IDENTITY PROVIDER VALIDATES QR CODE, EVALUATES TRUST LEVEL FOR WEBSITE
612
IDENTITY PROVIDER CREATES SECURITY TOKEN FOR WEBSITE
614
IDENTITY PROVIDER PROVIDES SECURITY TOKEN TO WEBSITE UPON REQUEST.
616

FIG. 6

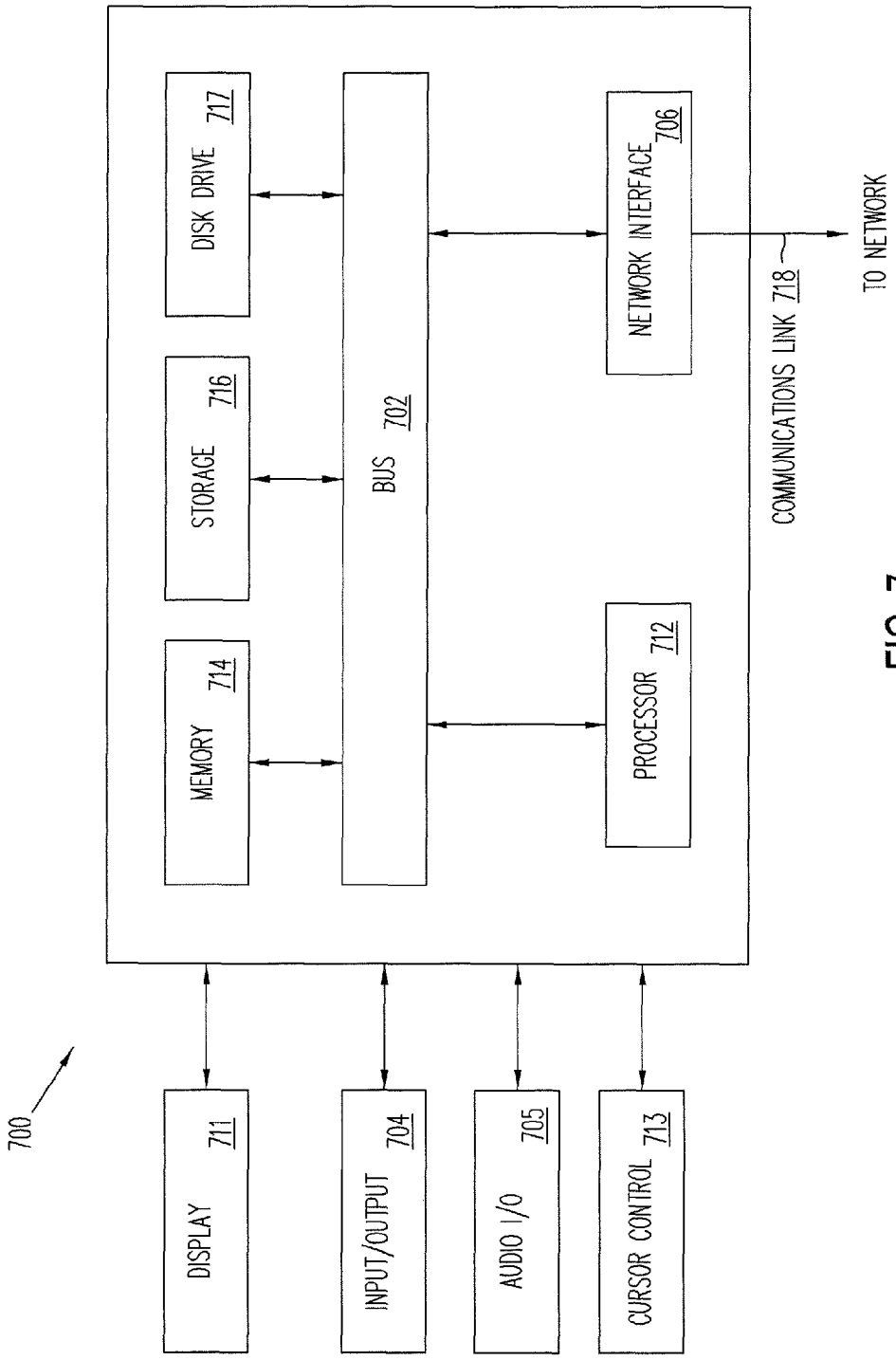

700
DISPLAY 711
INPUT/OUTPUT 704
AUDIO I/O 705
CURSOR CONTROL 713
MEMORY 714
STORAGE 716
DISK DRIVE 717
BUS 702
PROCESSOR 712
NETWORK INTERFACE 706
COMMUNICATIONS LINK 718
TO NETWORK

FIG. 7

LOGIN USING QR CODE

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of U.S. patent application Ser. No. 13/768,336, filed Feb. 15, 2013, which claims priority to and benefit of U.S. Provisional Patent Application Ser. No. 61/600,444, filed on Feb. 17, 2012, and U.S. Provisional Patent Application Ser. No. 61/621,823, filed on Apr. 9, 2012, all contents of which are hereby incorporated by reference in their entirety.

TECHNICAL FIELD

The present disclosure relates generally to systems and methods for authenticating users over a computer network. In particular, the present disclosure relates to methods and systems for using trusted devices to broker secure logins into websites from devices that may be insecure.

BACKGROUND

Internet users are frequently asked to login to websites from publicly shared devices. These devices may be inherently insecure as they may be infected with malware, or otherwise compromised by key-logger spyware, etc. Users entering their login credentials into unsecure devices face the risk of exposing their login credentials to unauthorized parties. Thus, there is a need for users to login to websites without entering sensitive information on insecure devices. Even when the devices are secure, there are situations where it may be difficult for users to manually enter credentials into the devices, such as on devices with limited input capabilities. While systems have been proposed to more securely authenticate users, these systems may require special hardware such as biometrics readers or near field communication (NFC) devices. In addition, even NFC devices may be compromised to expose sensitive information. To increase security, some websites may implement secondary authentication mechanism such as requiring users to use fobs or other second factor devices. However, these devices are inconvenient for users to carry. Accordingly, it is desirable to provide ways to users to login to websites securely, conveniently, and efficiently.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a system for a user to use a trusted device to scan QR code displayed on a display of an untrusted device to supply sensitive information to an, identity provider for the identity provider to broker a login to a website according to one or more embodiments of the present disclosure;

FIG. **2** shows a flow chart of the steps for an identity provider to generate QR code for a website and to validate the QR code received from a trusted device to generate a security token to broker a login to the website according to one or more embodiments of the present disclosure;

FIG. **3** shows a flow chart of the steps for a user to use a trusted device to scan QR code displayed on an untrusted device to provide sensitive information to an identity provider for the identity provider to broker a login to a website or for the website to request additional information from the user according to one or more embodiments of the present disclosure;

FIG. **4** shows a flow chart of the steps for a website server to request QR code and to receive security token from an identity provider for the website server to login a user or display protected resources to the user according to one or more embodiments of the present disclosure;

FIG. **5** shows a flow chart of the steps for an identity provider to generate QR code for a website to request additional information from a user and to receive the QR code from a trusted device to provide the requested additional information to the website according to one or more embodiments of the present disclosure;

FIG. **6** shows a flow chart of the steps for an identity provider to generate QR code for a website for second factor authentication of a user and to receive the QR code from a trusted device to generate a security token to broker a login to the website according to one or more embodiments of the present disclosure; and

FIG. **7** is a block diagram of a computer system suitable for implementing one or more components discussed herein according to one embodiment of the present disclosure.

Embodiments of the present disclosure and their advantages are best understood by referring to the detailed description that follows. It should be appreciated that like reference numerals are used to identify like elements illustrated in one or more of the figures.

DETAILED DESCRIPTION

Systems and methods are disclosed herein for a user to use a trusted device to provide sensitive information to an identity provider via QR (Quick Response) code for the identity provider to broker a login to a website or to assist in the authentication of the user by the website. The identity provider may be a service provider that facilitates transactions between the user and the website. Users may securely transact with the website from unsecured devices without the risk of exposing sensitive information to unauthorized parties running malware or key logger spyware on the unsecured devices. The QR code may be generated by the identity provider when the website desires to obtain sensitive information from users. The website may display the QR code on the unsecured devices. A user running a trusted application from the identity provider on the trusted device may scan the QR code to transmit the QR code to the identity provider. The identity provider may validate the QR code and prompt the user for the sensitive information. The identity provider may validate the QR code and may evaluate a trust level of the user to generate a security token based on the type of sensitive information received and/or the level of authentication performed on the user. The identity provider may provide the security token to the website for the website to display protected resources corresponding to the security token on the unsecured devices. Advantageously, the user may perform a safe login to the website from untrusted devices such as publicly shared devices.

The systems and methods disclosed may be used as a second factor authentication even after the user has entered login information directly into the unsecured devices. For example, the website may, through the identity provider, perform additional authentication of the user via QR code to increase the trust level of the user so as to prevent logins by fraudsters. The website may request the identity provider to generate QR code to prompt the user to provide information for the second factor authentication. The website may display the QR code on the unsecured devices. A user running a trusted application from the identity provider on the trusted device may scan the QR code for transmission to the identity provider. The identity provider may validate the QR code and may prompt the user for the information. The identity provider may evaluate the trust level of the user based on the

credentials entered into the trusted device when the user logs into the identity provider, on the characteristics of the trusted device, and/or on other information entered by the user. The identity provider may generate a security token based on the level of trust of the user. The website may use the security token to guard against unauthorized logins. Advantageously, the user may avoid the need to carry second factor devices such as fobs for websites that implement second factor authentication mechanism when logging in from untrusted devices.

The systems and methods disclosed may also be used to securely collect additional sensitive information or credentials from the user even after the user has logged into the website on the unsecured device. For example, the website may request the identity provider to generate additional QR code when the website desires to collect additional sensitive information from the user when the user is already logged in. The website may request the identity provider to generate QR code to prompt the user to provide the additional information. The website may display the QR code on the unsecured devices. A user running a trusted application from the identity provider on the trusted device may scan the QR code for transmission to the identity provider. The identity provider may validate the QR code and may prompt the user for the information. The user may enter the requested information through the trusted application on the trusted device. The identity provider may collect and provide the information to the website. In one or more embodiments, if the user is connected to the identity provider through the trusted app, the website may request the identity provider to directly prompt the user for the additional information without going through the QR code. Advantageously, the user may securely enter sensitive information to the website anytime during a login session when conducting transactions with the website from untrusted devices.

Advantageously, the user may securely access websites from devices that may be unsecure, or have no or limited input capabilities. Security is enhanced because the user is not required to enter login credentials or other sensitive information into the unsecured devices that may be stolen, seen, or copied. The QR code itself does not need to contain an URL of the website, but may be encrypted to contain just enough information to uniquely identify the website and to tie the transactions together. The trusted application from the identity provider running on the trusted device and the identity provider provide a bridge through which the user may provide sensitive information to the website securely, conveniently, and efficiently.

In accordance with one or more embodiments of the present disclosure, a method is disclosed. The method includes generating by an identity provider a code for display by a website on an untrusted device. The identity provider uses the code to broker a transaction with the website. The method also includes receiving by the identity provider from a trusted device credential information to identity a user. The method further includes authenticating the user using the credential information. The method further includes receiving by the identity provider the code from the trusted device. The method further includes validating the received code. The method further includes generating by the identity provider information to enable the website to perform the transaction with the user on the untrusted device. The method further includes providing the information from the identity provider to the website.

In accordance with one or more embodiments of the present disclosure, a method is disclosed. The method includes requesting by a website a code from an identity provider, where the code is used by the identity provider to broker a transaction of a user with the website. The method also includes receiving by the website the code from the identity provider. The method further includes displaying the code on an untrusted device. The method further includes receiving by the website transactional information from the identity provider. The transactional information is generated by the identity provider based on information received from a trusted device. The method further includes performing by the website the transaction using the transactional information.

In accordance with one or more embodiments of the present disclosure, an apparatus is disclosed. The apparatus includes a network interface. The network interface is used to communicate with a website server and other devices over a network. The apparatus also includes a code generation unit. The code generation unit is used to generate a code for display by the website server on an untrusted device. The code is used to by the apparatus to broker a transaction with the website. The apparatus further includes an authentication and trust services unit. The authentication and trust services unit is used to receive credential information to identity a user from a trusted device. The authentication and trust services unit is also used to authenticate the user from the credential information. The authentication and trust services unit is further used to receive the code from the trusted device. The authentication and trust services unit is further used to validate the code. The authentication and trust services unit is further used to generate information for the website server to enable the website server to perform the transaction with the user on the untrusted device.

Refer now to the figures wherein the drawings are for purposes of illustrating embodiments of the present disclosure only, and not for purposes of limiting the same. FIG. **1** shows a system for a user to use a trusted device to scan QR code displayed on a display of an untrusted device to supply sensitive information to an identity provider for the identity provider to broker a login to a website according to one or more embodiments of the present disclosure.

A user **100** carries a trusted device **102**. Trusted device **102** may be a smart phone (e.g., iPhone, Google phone, or other phones running Android, Window Mobile, or other operating systems), a tablet computer (e.g., iPad, Galaxy), personal digital assistant (PDA), a notebook computer, or various other types of wireless or wired computing devices. It should be appreciated that trusted device **102** may be referred to as a mobile device without departing from the scope of the present disclosure. Trusted device **102** may have a camera. Trusted device **102** may communicate over a network **106** with an identity provider **108**. A website server **116** hosts a website and may also communicate with identity provider **108** over network **106**. The website may be operated by a financial institution, a merchant, or other entities providing secured access to authorized users. In one embodiment, identity provider **108** may broker a login session to website server **116** by user **100**.

Network **106** may be implemented as a single network or a combination of multiple networks. For example, in various embodiments, network **106** may include the Internet and/or one or more intranets, wireless networks (e.g., cellular, wide area network (WAN), WiFi hot spot, WiMax, personal area network (PAN), Bluetooth, etc.), landline networks and/or other appropriate types of communication networks. As such, in various embodiments, trusted device **102** may be associated with a particular link (e.g., a link, such as a URL (Uniform Resource Locator) to an IP (Internet Protocol) address).

In one or more embodiments, user **100** is at an untrusted device **104** and wishes to access the website on website server **116**. Untrusted device **104** may be a publicly shared device whose security is unknown. To eliminate the risk of exposing sensitive information when such information is entered directly onto untrusted device **104**, trusted device **102** and identity provider **108** may be used to broker access to website server **116**.

To broker access to website server **116** by user **100**, identity provider **108** may have a network interface **110** that interfaces with network **106** to communicate with trusted device **102** and website server **116**. A QR code generation unit **112** of identity provider **108** may generate QR code when requested by website server **116**. The QR code may not contain an URL of website server **116**, but may encrypt information to allow identity provider **108** to uniquely identity website server **116** and to enable identity provider **108** to associate user **100**/trusted device **102** with a login session or a transaction on website server **116**. For example, QR code may encode information to prompt user **100** to initiate a safe login session to website server **116**, or to prompt user **100** to provide information required to complete a transaction by website server **116**. The QR code generated by identity provider **108** is not readable by standard QR code readers and the encrypted information may only be decrypted by identity provider **108**. Website server **116** may display the QR code on untrusted device **104**. While the exemplary embodiments described herein use QR code, identity provider **108** may generate other types of symbol or data encoding schemes, such as UPC code. Website server **116** may similarly display these data encoding schemes on untrusted device **104** for capture or scan by trusted device **102**.

To scan the QR code, user **100** may run a trusted app (application) from identity provider **108** on trusted device **102**. The trusted app identifies trusted device **102** to identity provider **108** through network **106**. The trusted app and trusted device **102** have previously been registered with identity provider **108** by user **100**. As such, when the trusted app communicates with identity provider **108**, a security level is established for user **100**. To increase the security level, in one or more embodiments, user **100** may login to user's account with identity provider **108**. User **100** may enter a user name and password such as an e-mail address and a PIN for the login credentials. User **100** may enter the information on trusted device **102** through a keyboard, keypad, touchscreen, or using voice command User **100** may scan the QR code displayed on untrusted device **104**. The trusted application decodes the scanned QR code and transmits the information to identity provider **108**. In one or more embodiments, the trusted application may transmit the QR code image to identity provider **108** for decoding.

An authentication and trust services unit **114** of identity provider **108** validates the QR code received from trusted device **102**. Identity provider **108** may verify that the QR code identifies a website that has requested identity provider **108** to broker an access, such as from website server **116**. Identity provider **108** may also verify that the QR code is associated with a safe login session or with a request by website server **116** to request additional information from user **100** to further authenticate user **100** or to complete a transaction. If website server **116** is requesting additional information, identity provider **108** may transmit a request to trusted device **102** to prompt user **100** to enter the information on trusted device **102**. For example, identity provider **108** may request user **100** to provide login credentials to website server **116** for second factor authentication. In one embodiment, trusted device **102** may store the login credentials entered by user **100** so that the login credentials are automatically sent to identity provider **108** for second factor authentication the next time user **100** accesses website server **116**. Alternatively, identity provider **108** may request user **100** to provide sensitive information to complete a transaction on website server **116**. User **100** may enter the requested information into trusted app for trusted device to transmit the information to identity provider **108**

After validating the QR code, authentication and trust servers unit **114** evaluates the security level for user **100**/trusted device **102**, any additional login credentials received from user **100**, and past history of trusted device **102** to determine a level of trust for user **100**/trusted device **102**. Authentication and trust servers unit **114** may create a security token for user **100** corresponding to the level of trust determined. For example, if user **100** has not logged into identity provider **108** or website server **116**, the security token may have a low level of trust for user **100**. On the other hand, if user **100** has logged into identity provider **108** and has passed second factor authentication, the security token may have a high level of trust for user **100**. Identity provider **108** may store the security token for retrieval by website server **116**.

Website server **116** may use a network interface **118** to poll identity provider **108** to detect if a security token has been generated. In one or more embodiments, identity provider **108** may inform website server **116** that a security token is available for retrieval. In one or more embodiments, identity provider **108** may issue an instruction to trusted device **102** directing user **100** how to proceed. For example, when establishing a safe login session, identity provider **108** may direct user **100** to click on the QR code or a "safe login" button on untrusted device **104** to proceed with the login session. When user **100** does as directed, website server **116** may retrieve the security token and may inform user **100** on untrusted device **104** that a login session has been established. A login authentication unit **120** of website server **116** may evaluate the security token to determine the protected resources, if any, that may be accessed by user **100**. Website server **116** may access a protected resources unit **122** to display the protected resources on untrusted device **104** for user **100** to access. When the QR code was generated for website server **116** to request additional information from user **100**, identity provider **108** may direct user **100** to click on the QR code on untrusted device **104** for website server **116** to retrieve the requested information from identity provider **108**. When user **100** does as directed, website server **116** may retrieve the requested information to complete the transaction.

FIG. **2** shows a flow chart of the steps for an identity provider of FIG. **1** to generate QR code for a website and to validate the QR code received from a trusted device to generate a security token to broker a login to the website according to one or more embodiments of the present disclosure. In **202**, identity provider **108** receives a request for a QR code for a login session from website server **116**. The QR code may encrypt information to allow identity provider **108** to uniquely identity website server **116** and to enable identity provider **108** to associate user **100**/trusted device **102** with a login session on website server **116**. For example, the QR code may contain a key for retrieval of the security token associated with user **100**/trusted device **102** for the login session, an identifier for website server **116**, and a time stamp. The time stamp may indicate a period of validity of the QR code.

In **204**, QR code generation unit **112** of identity provider **108** generates the QR code. QR code generation unit **112** may encrypt an amount of data and size the QR code such that the QR code may be scanned and decoded from a reasonable distance by trusted device **102**. To prevent a rogue site from

putting up QR code masquerading as QR code generated by identity provider **108** to steal login credentials from user **100**, the QR code may be generated to be read only by trusted app from identity provider **108** running on trusted device **102**, and not by standard QR code readers. In one or more embodiments, the encoded data may only be decrypted by identity provider **108**. In one or more embodiments, the encoded data may be decrypted by the trusted app from identity provider **108**. In addition, to mitigate DDOD (Distributed Denial-of-Service) concerns and to ensure that QR code generation does not become a risk to identity provider **108**, rate limiting may be implemented on the QR code generation. QR code generation unit **112** may also generate the QR code on a "best effort" basis. If the QR code is generated by a service, there may be a dedicated pool of QR code that is considered best effort.

Identity provider **108** provides the QR code to website server **116** for website server **116** to display the QR code on a login page on untrusted device **104**. Website server **116** may also display a "QR code safe login" button on untrusted device **104** to inform users that the QR code is for initiating a safe login. The button may also be clicked by users after identity provider **108** has generated the security token for website server **116** to retrieve the security token from identity provider **108**. To scan the QR code, user **100** runs a trusted app from identity provider **108** on trusted device **102**. Trusted device **102** has previously been registered with identity provider **108** as belonging to user **100** so that a security level is established for user **100** when trusted app communicates with identity provider **108**. The security level is one factor identity provider **108** evaluates when generating the security token for the safe login session. The higher the security level of user **100**, the higher the level of trust in the security token generated for user **100**, and the more of the protected resources of website server **116** may be accessible by user **100**. To increase the security level, user **100** may enter login credentials for identity provider **118** into the trusted app.

In **206**, identity provider **108** determines if user **100** has provided login credentials from trusted device **102**. If login credentials are received, in **208**, identity provider **108** logs in user **100** and increases the security level for user **100**. Otherwise, the security level remains unchanged. The trusted app may display a "safe login" icon. User **100** may click on the "safe login" icon to enable the camera on trusted device **102** to scan the QR code displayed on untrusted device **104**. The trusted app decodes the scanned QR code and transmits the data to identity provider **108**.

In **210**, identity provider **210** receives the decoded QR code from trusted device **102**. In one or more embodiments, identity provider **210** may receive the un-decoded QR code from trusted device **102**. Authentication and trust services unit **114** of identity provider **108** may, if necessary, decode the QR code and may decrypt the decoded data. In **212**, identity provider **108** determines if additional information is needed from user **100** for authentication by website server **116**. The additional information may include login credentials to website server **116** or may include other sensitive information of user **100**. If additional information is needed, identity provider **108** may prompt user **100** for the information on trusted device **102**. In **214**, identity provider **108** receives the additional information from trusted device **102**.

In **216**, authentication and trust services unit **114** validates the QR code. Authentication and trust services unit **114** may verify that the time stamp for the QR code has not expired, that the QR code identifies website server **116**, and that the key for retrieval of the security token is associated with a safe login session. Authentication and trust services unit **114** also evaluates the security level for user **100**, any additional information received from user **102**, and history of trusted device **102** to determine a level of trust for user **100**. For example, if there is increased security level because user **100** has logged into identity provider **108**, user **100** has provided additional information such as login credentials for website server **116**, and there is no history of fraudulent use associated with trusted device **102**, a high level of trust may be determined for user **100**. On the other hand, if there is just a regular security level because user **100** has not logged into identity provider **108**, and user **100** has not provided additional information for website server **116**, a lower level of trust may be determined for user **100**.

In step **218**, authentication and trust services unit **114** generates a security token corresponding to the level of trust determined for user **100**. Identity provider **108** may inform website server **116** that a security token for a safe login session is available. In one or more embodiments, identity provider **108** may transmit a message to trusted device **102** instructing user **100** to request website server **116** to retrieve the security token. For example, user **100** may be instructed to click on the QR code or the "QR code safe login" button displayed on untrusted device **104**. When user **100** clicks on the QR code or the button, website server **116** requests the security token from identity provider **108**. In **220**, identity provider **108** provides the security token for user **100** to website server **116**. Website server **116** may evaluate the security token to establish a login session for user **100** and may present protected resources corresponding to the level of trust of the security token on untrusted device **104** for user **100** to access. In one or more embodiments, identity provider **108** may provide to website server **116** the additional information received from trusted device **102**, such as the login credentials to website server **116**. Website server **116** may use the additional information to further authenticate user **100** or to determine the protected resources presented to user **100**.

FIG. **3** shows a flow chart of the steps for a user to use a trusted device to scan QR code displayed on an untrusted device of FIG. **1** to provide sensitive information to an identity provider for the identity provider to broker a login to a website or for the website to request additional information from the user according to one or more embodiments of the present disclosure. User **100** may execute the steps of FIG. **3** when user **100** wishes to login to website server **116** at untrusted device **104**. User **100** may also execute the steps of FIG. **3** when use **100** is already logged in to website server **116** at untrusted device **104** but website server needs additional information from user **100** to complete a transaction.

In **302**, user **100** starts a trusted app from identity provider **108** on trusted device **102**. The trusted app may transmit identification information of trusted device **102** to identity provider **108**. Trusted device **102** has previously been registered by user **100** with identity provider **108**. Therefore, identity provider **108** may associate the transmission from trusted device **102** with user **100** to establish a security level for user **100**. To increase the security level, user **100** may login to identity provider **108**. In **304**, user **100** decides whether to login to user's account with identity provider **108**. If the answer is yes, user **100** enters user's login credentials into trusted device in **306**. Identity provider **108** may authenticate user **100** to increase the security level.

In **308**, user **100** scans the QR code displayed on untrusted device **104** using the trusted app. The QR code may encode information to allow user **100** to request a safe login session with website server **116** or to allow website server **116** to request additional information from user **100** after user **100** is already logged in. User **100** may scan the QR code using the

trusted app regardless of whether user **100** has logged in with identity provider **108**. The trusted app may decode the QR code or may rely on identity provider **108** to decode the QR code. In **310**, trusted app transmits the decoded or un-decoded QR code to identity provider **108**. Identity provider **108** may decode and/or decrypt the QR code. Identity provider **108** may validate the QR code to determine whether the QR code is used for a safe login or to obtain additional information from user **100**. If the QR code is used for a safe login, additional information may be needed from user **100** for authentication by identity provider **108** or website server **116**. For example, the additional information may include login credentials to website server **116**. If the QR code is used to obtain additional information from user **100** to complete a transaction, identity provider **108** may determine the type of information needed.

In **312**, identity provider **108** determines if it needs additional information from user **100**. If it does, identity provider **108** transmits a message to trusted device **102** on the information needed. Trusted device **102** may prompt user **100** to enter the requested information. In **314**, user enters the information into trusted app for trusted device **102** to transmit the information to identity provider **108**. In one or more embodiments, trusted device **102** may store the entered information so that the information may be provided to identity provider **108** without user input. If trusted device **102** is used to broker a safe login, identity provider **108** may evaluate the security level for user **100**, any authentication information received, and history of trusted device **102** to determine the level of trust. Identity provider **108** may generate a security token corresponding to the level of trust. If trusted device **102** is used to provide additional information to website server **116** to complete a transaction after user **100** has already logged in, identity provider **108** may store the additional information.

In **316**, trusted device **102** receives a message from identity provider **108** that a security token has been generated or that the requested information has been received. The message may contain instructions directing user **100** how to activate website server **116** to retrieve the security token or the additional information. For example, user **100** may be directed to input a command to website server **116** such as to click on the QR code displayed on untrusted device **104**. User **100** inputs the command as directed. Website server **116** retrieves the security token or the additional information from identity provider **108**. Website server **116** may establish a safe login session and may display protected resources on untrusted device **104** based on the security token. In **318**, user accesses the protected resources through untrusted device **104**. In the case where website server **116** obtains additional information for user **100** who is already logged in, website server **116** may use the additional information to complete a transaction. User **100** may proceed to carry out transactions with website server **116** on untrusted device and may close the trusted app on trusted device **102**.

FIG. **4** shows a flow chart of the steps for a website server of FIG. **1** to request QR code and to receive security token from an identity provider for the website server to login a user or display protected resources to the user according to one or more embodiments of the present disclosure. Website server **116** may use the QR code when website server **116** requests sensitive information from user **100**. For example, website server **116** may use the QR code to allow user **100** to initiate a safe login session using trusted device **102**. In one or more embodiments, website server **116** may use the QR code to request credentials for second factor authentication when user **100** has entered login information directly into unsecured device **104**. In one or more embodiments, website server **116** may use the QR code to securely collect additional sensitive information when user **100** is already logged into website server **116** to complete a transaction.

In **402**, website server **116** requests identity provider **108** to generate a QR code. Website server **116** may provide information that identifies website server **116** and untrusted device **104** to identity provider **108**. In addition, website server **116** may provide metadata that identifies the type of information requested by website server **116**. Identity provider **108** may generate a QR code that uniquely identifies website server **116** and that ties a transaction for a login session on untrusted device **104** to website server **116**.

In **404**, website server **116** receives the QR code from identity provider **108**. In **406**, website server **116** displays the QR code on untrusted device **104**. For example, for a safe login session, website server **116** may display the QR code and a "QR code safe login" button on untrusted device **104** to inform users that the QR code may be scanned to initiate a safe login using trusted device **102**. In one or more embodiments, website server **116** may display the QR code and a message on untrusted device **104** that user **100** is requested to provide additional information using trusted device **102**. If the QR code is used for a safe login session, when user **100** scans the QR code with trusted device **102** using the trusted app from identity provider **108**, identity provider **108** may generate a security token for user **100** corresponding to a level of trust. If the QR is used to collect additional information from user **100**, when user **100** scans the QR code, identity provider **108** may transact with user **100** to collect the additional information via trusted device **102**.

In **408**, website server **116** determines if the security token or the additional information is available from identity provider **108**. In one or more embodiments, website server **116** may poll identity provider **108**. In one or more embodiments, website server **116** may receive a activation command from user **100** that the security token or the additional information is available when user **100** clicks on the QR code displayed on untrusted device **104** as directed by identity provider **108**. Website server **116** may retrieve the security token or the additional information. Website server **116** may use the additional information to authenticate user **100** using login authentication unit **120**. In one or more embodiments, website server **116** may use the additional information to complete the transaction requiring the information. Website server **116** may proceed to carry out transactions with user **100** on untrusted device **104**.

In **410**, if the security token was retrieved by website server **116** for a safe login session, login authentication unit **120** may evaluate the security token to determine the protected resources, if any, that may be accessed by user **100**. Website server **116** may access protected resource unit **122** to access the protected resources. In **412**, website server **116** establishes the safe login session and presents the protected resource on untrusted device **104** for user **100** to access.

FIG. **5** shows a flow chart of the steps for an identity provider of FIG. **1** to generate QR code for a website to request additional information from a user and to receive the QR code from a trusted device to provide the requested additional information to the website according to one or more embodiments of the present disclosure. Website server **116** may request the additional information after user **100** is already logged into website server **116**.

In **512**, identity provider **108** receives a request from website server **116** to generate a QR code to collect additional information from user **100**. Identity provider **108** may receive from website server **116** metadata that identifies the type of requested information, in addition to information that identi-

fies website server **116** and untrusted device **104**. In **514**, identity provider **108** generates a QR code that associates the requested information for a login session on untrusted device **104** with website server **116**. Identity provider **108** may transmit the QR code to website server **116**. Website server **116** may display the QR code on untrusted device **104** with a notification that user **100** is requested to scan the QR code to provide the information. User **100** may start the trusted app from identity provider **108** on trusted device **102** to scan the QR code.

In **516**, identity provider **108** receives the QR code from trusted device **102**. Identity provider **108** may decode and/or decrypt the QR code the decoded data. In **518**, identity provider **108** validates the QR code to verify that the QR code is associated with a request for information for a login session on untrusted device **104** with website server **116**. Identity provider **108** may identify from the metadata the requested information and may transmit a message to trusted device **102** prompting user **100** for the requested information.

In **520**, identity provider **108** receives the requested information from trusted device **102**. Identity provider **108** may transmit a message to trusted device **102** directing user **100** to instruct website server **116** to retrieve the collected information from identity provider **108**, such as by directing user **100** to click on the QR code displayed on untrusted device **104**. Upon receiving the command from user **100**, website server **116** may request the collected information from identity provider **108**. In **522**, identity provider **108** provides the requested information to website server **116**. Website server **116** may use the information to complete a transaction. User **100** may transact with website server **116** on untrusted device **104** until additional information is required, at which point identity provider **108** may repeat the steps of FIG. **5** to collect the information for website server **116**.

FIG. **6** shows a flow chart of the steps for an identity provider of FIG. **1** to generate QR code for a website for second factor authentication of a user and to receive the QR code from a trusted device to generate a security token to broker a login to the website according to one or more embodiments of the present disclosure. Website server **116** may perform second factor authentication after user **100** has entered login information directly into untrusted device **104** so as to increase the trust level of user **100**.

In **602**, identity provider **108** receives a request from website server **116** to generate a QR code to collect credential information from user **100**/trusted device **102** for second factor authentication. Identity provider **108** may receive from website server **116** information identifying website server **116** and untrusted device **104**. In **604**, identity provider **108** generates a QR code that associates the requested credentials with website server **116**. Identity provider **108** may transmit the QR code to website server **116**. Website server **116** may display the QR code on untrusted device **104** with a notification that user **100** is requested to scan the QR code to provide the credentials. User **100** may start the trusted app from identity provider **108** on trusted device **102** to scan the QR code. When the trusted app communicates with identity provider **108**, a security level is established for user **100** associated with trusted device **102**. To increase the security level, user **100** may be prompted to enter login credentials with identity provider **108**.

In **606**, identity provider **108** determines if user **100** has provided the login credentials from trusted device. If user **100** has provided the login credentials, identity provider **108** authenticates user **100** in **608**. Identity provider **108** may increase the security level for user **100** if user **100** is successfully authenticated. In **610**, identity provider **108** receives the QR code from trusted device **102**. Identity provider **108** may decode and/or decrypt the QR code the decoded data. In **612**, identity provider **108** validates the QR code to verify that the QR code is associated with a request for second factor authentication with website server **116**. Identity provider **108** may evaluate a level of trust for user **100** based on the characteristics and history of trusted device **102**, and the security level of user **100**.

In **614**, identity provider **108** generates a security token based on the level of trust determined for user **100**. Identity provider **108** may transmit a message to trusted device **102** directing user **100** to instruct website server **116** to retrieve the security token from identity provider **108**, such as by directing user **100** to click on the QR code displayed on untrusted device **104**. Upon receiving the command from user **100**, website server **116** may request the security token from identity provider **108**. In **616**, identity provider **108** provides the security token to website server **116**. Website server **116** may evaluate the security token to determine the protected resources, if any, that may be accessed by user **100**. Website server **116** establishes the safe login session and presents the protected resource on untrusted device **104** for user **100** to access. Thus, website server **116** may perform second factor authentication for user **100** without requiring user **100** to carry second factor devices such as fobs or other second factor devices.

FIG. **7** is a block diagram of a computer system **700** suitable for implementing one or more embodiments of the present disclosure. In various implementations, the trusted device of the user may comprise a personal computing device (e.g., smart phone, a computing tablet, a personal computer, laptop, PDA, Bluetooth device, key FOB, badge, etc.) capable of communicating with the network. The website server or the identity provider may utilize a network computing device (e.g., a network server) capable of communicating with the network. It should also be appreciated that the trusted app from the identity provider may be implemented as applications running on computer system **700**.

Network computing device may comprise or implement a plurality of servers and/or software components that operate to perform various methodologies in accordance with the described embodiments. Exemplary servers may include, for example, stand-alone and enterprise-class servers operating a server OS such as a MICROSOFT® OS, a UNIX® OS, a LINUX® OS, or other suitable server-based OS. It can be appreciated that the servers illustrated in FIG. **7** may be deployed in other ways and that the operations performed and/or the services provided by such servers may be combined or separated for a given implementation and may be performed by a greater number or fewer number of servers. One or more servers may be operated and/or maintained by the same or different entities.

Computer system **700** includes a bus **702** or other communication mechanism for communicating information data, signals, and information between various components of computer system **700**. Components include an input/output (I/O) component **704** that processes a user action, such as selecting keys from a keypad/keyboard, selecting one or more buttons or links, etc., and sends a corresponding signal to bus **702**. I/O component **704** may also include an output component such as a display **711**, and an input control such as a cursor control **713** (such as a keyboard, keypad, mouse, etc.). An optional audio input/output component **705** may also be included to allow a user to use voice for inputting information by converting audio signals into information signals. Audio I/O component **705** may allow the user to hear audio. A transceiver or network interface **706** transmits and receives

signals between computer system **700** and other devices, such as another user device, or another network computing device via a communication link **718** to a network. In one embodiment, the transmission is wireless, although other transmission mediums and methods may also be suitable. A processor **712**, which can be a micro-controller, digital signal processor (DSP), or other processing component, processes these various signals, such as for display on computer system **700** or transmission to other devices via communication link **718**. Processor **712** may also control transmission of information, such as cookies or IP addresses, to other devices.

Components of computer system **700** also include a system memory component **714** (e.g., RAM), a static storage component **716** (e.g., ROM), and/or a disk drive **717**. Computer system **700** performs specific operations by processor **712** and other components by executing one or more sequences of instructions contained in system memory component **714**. Logic may be encoded in a computer readable medium, which may refer to any medium that participates in providing instructions to processor **712** for execution. Such a medium may take many forms, including but not limited to, non-volatile media, volatile media, and transmission media. In various implementations, non-volatile media includes optical, or magnetic disks, or solid-state drives, volatile media includes dynamic memory, such as system memory component **714**, and transmission media includes coaxial cables, copper wire, and fiber optics, including wires that comprise bus **702**. In one embodiment, the logic is encoded in non-transitory computer readable medium. In one example, transmission media may take the form of acoustic or light waves, such as those generated during radio wave, optical, and infrared data communications.

Some common forms of computer readable media includes, for example, floppy disk, flexible disk, hard disk, magnetic tape, any other magnetic medium, CD-ROM, any other optical medium, punch cards, paper tape, any other physical medium with patterns of holes, RAM, PROM, EEPROM, FLASH-EEPROM, any other memory chip or cartridge, or any other medium from which a computer is adapted to read.

In various embodiments of the present disclosure, execution of instruction sequences to practice the present disclosure may be performed by computer system **700**. In various other embodiments of the present disclosure, a plurality of computer systems **700** coupled by communication link **718** to the network (e.g., such as a LAN, WLAN, PTSN, and/or various other wired or wireless networks, including telecommunications, mobile, and cellular phone networks) may perform instruction sequences to practice the present disclosure in coordination with one another.

Where applicable, various embodiments provided by the present disclosure may be implemented using hardware, software, firmware, or combinations thereof. Also where applicable, the various hardware components, software components, and/or firmware components set forth herein may be combined into composite components comprising software, firmware, hardware, and/or all without departing from the spirit of the present disclosure. Where applicable, the various hardware components, software components, and/or firmware components set forth herein may be separated into sub-components comprising software, firmware, hardware, or all without departing from the spirit of the present disclosure. In addition, where applicable, it is contemplated that software components may be implemented as hardware components, and vice-versa.

Application software in accordance with the present disclosure, such as computer programs executed by a processor of the identity provider to generate/validate QR code and to generate the security token, by a processor of the website server to evaluate the security token to display the protected resources, or by the trusted app to scan the QR code, may be stored on one or more computer readable mediums. It is also contemplated that the application software identified herein may be implemented using one or more general purpose or specific purpose computers and/or computer systems, networked and/or otherwise. Where applicable, the ordering of various steps described herein may be changed, combined into composite steps, and/or separated into sub-steps to provide features described herein.

Although embodiments of the present disclosure have been described, these embodiments illustrate but do not limit the disclosure. For example, even though QR code is a mature technology with large information storage capacity, other code, symbols, text, or objects that may be recognized quickly and accurately by trusted devices may be used for the safe login or for the information request. For example, UPC code can be generated by the identity provider, which then can be scanned by the trusted device to accomplish the safe login process or the information request by the website server as discussed herein. It should also be understood that embodiments of the present disclosure should not be limited to these embodiments but that numerous modifications and variations may be made by one of ordinary skill in the art in accordance with the principles of the present disclosure and be included within the spirit and scope of the present disclosure as hereinafter claimed.

We claim:

1. A provider server system, comprising:

a non-transitory memory comprising instructions; and

one or more hardware processors coupled to the non-transitory memory, and configured to read the instructions to cause the provider server system to perform operations comprising:

generating, by a code generation unit of the one or more hardware processors, encoded data;

transmitting the encoded data to a first device to display quick response data on a graphical user interface (GUI) of the first device;

receiving credential information from a second device, wherein the credential information corresponds to the quick response data processed by a quick response component of the second device based at least on a physical scan of the quick response data displayed on a surface of the GUI interface of the first device;

determining a level of trust associated with the credential information that corresponds to the quick response data processed by the quick response component of the second device based at least on the physical scan of the quick response data displayed on the surface of the GUI interface of the first device; and

sending a security token to a website server that enables a data transmittal associated with the first device and the website server based at least on the level of trust determined.

2. The provider server system of claim **1**, wherein the data transmittal is initiated based at least on a safe login session with the website server and the first device.

3. The provider server system of claim **2**, wherein the one or more hardware processors is configured to read the instructions to cause the provider server system to perform further operations comprising generating the security token based at least on the level of trust determined and the safe login session with the website server and the first device.

4. The provider server system of claim 3, wherein sending the security token to the website server comprises sending the security token to enable the first device to display protected resources that correspond to the security token.

5. The provider server system of claim 1, wherein the credential information further comprises information that identifies the second device, and wherein the one or more hardware processors is configured to read the instructions to cause the provider server system to perform further operations comprising:

identifying a user of the second device based at least on the credential information received from the second device; and

authenticating the user based at least on the information that identifies the second device, wherein the second device is registered by the user.

6. The provider server system of claim 1, wherein the credential information comprises login information of a user of the second device, and wherein the one or more hardware processors is configured to read the instructions to cause the provider server system to perform further operations comprising:

authenticating the user based at least on the login information received.

7. The provider server system of claim 1, wherein the one or more hardware processors is configured to read the instructions to cause the provider server system to perform further operations comprising:

receiving authentication information of a user of the second device from the website server, and wherein the data transmittal is initiated based at least on the authentication information received.

8. The provider server system of claim 1, wherein the data transmittal is based on login information received by the first device and the security token sent to the website server.

9. The provider server system of claim 1, wherein the data transmittal is enabled based on additional information received by the website server and a successful login with the website server, and wherein the one or more hardware processors is configured to read the instructions to cause the provider server system to perform further operations comprising collecting the additional information from the second device.

10. A website server system, comprising:

a non-transitory memory comprising instructions; and

one or more hardware processors coupled to the non-transitory memory and configured to read the instructions to cause the website server system to perform operations comprising:

receiving encoded data transmitted from a provider server;

transmitting the encoded data to a first device to display quick response data on a graphical user interface (GUI) of the first device;

receiving a security token from the provider server based at least on a level of trust with a second device determined by the provider server, wherein the level of trust is associated with credential information received by the provider server that corresponds to the quick response data processed by a quick response component of the second device based at least on a physical scans of the quick response data displayed on a surface of the GUI interface of the first device; and

initiating a data transmittal with the first device based at least on the security token received.

11. The website server system of claim 10, wherein the data transmittal is initiated based at least on a safe login with the first device.

12. The website server system of claim 10, wherein the one or more hardware processors is further configured to read the instructions to cause the website server system to perform further operations comprising:

receiving the credential information from the provider server, wherein the credential information is received with the security token, and wherein initiating the data transmittal with the first device is further based on the credential information received.

13. The website server system of claim 12, wherein the one or more hardware processors is further configured to read the instructions to cause the website server system to perform further operations comprising:

evaluating, by a login authentication component, a trust level of the security token based at least on a safe login session with the first device; and

instructing the first device to display protected resources on the GUI interface of the first device based at least on the trust level evaluated.

14. The website server system of claim 10, wherein the one or more hardware processors is further configured to read the instructions to cause the website server system to perform further operations comprising:

receiving authentication information of the second device associated with a user, and wherein initiating the data transmittal is based at least on the authentication information.

15. The website server system of claim 10, wherein initiating the data transmittal comprises initiating is a transmittal of authentication information of a user responsive to login information received by the first device from a user.

16. The website server system of claim 10, wherein initiating the data transmittal comprises initiating a retrieval of additional information stored in the second device responsive to a user login with the first device determined by the website server system.

17. The website server system of claim 10, wherein the quick response component is further configured to decode and decrypt the quick response data.

18. A method comprising:

receiving, by a provider server, a request from a user device to initiate a data transmittal;

generating, by a code component of the provider server, encoded data responsive to the request to initiate the data transmittal;

transmitting, by the provider server, the encoded data to a shared device to display quick response data on a graphical user interface (GUI) of the shared device;

receiving, by the provider server, credential information from the user device, wherein the credential information corresponds to the quick response data processed by a quick response component of the user device based at least on a physical scan of the quick response data displayed on a surface of the GUI interface of the shared device;

determining a level of trust associated with the credential information that corresponds to the quick response data; and

sending, by the provider server, a token to a web server to enable the data transmittal requested based at least on the level of trust determined.

19. The method of claim 18, wherein the data transmittal is initiated based at least on a safe login with the first device.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,288,198 B2
APPLICATION NO. : 14/557646
DATED : March 15, 2016
INVENTOR(S) : Daniel B. DeSoto et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

In Claim 10:

Column 15, Line 62, change "physical scans" to --physical scan--.

Signed and Sealed this
Seventh Day of June, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office